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ABSTRACT

The full impact of the current information technology and networking revolution remains unknown, but the experiences of organizations and individuals who are using the tools and resources offered by information technology suggest that it may change our social fabric. Some of the current and emerging trends in information technology include: the need to overcome limitations of access due to economic status; timely solutions to the "Year 2000" problem; and the transformation of organizations due to decentralization and increased telecommuting. Public policy issues that face government include: electronic records management; privacy; security; network literacy; organizational change; intellectual property rights; information access, storage, and retrieval; and public-private partnerships. Over the long term, the strategic application and management of information technology can help Kentucky maximize the use of limited resources to meet its pressing needs, achieve a stronger competitive position in the global economy, meet the increasing demand for customer service, increase confidence in government, and approach solutions differently in such areas as education reform, employee development and empowerment, flexible manufacturing, and industrial revitalization. Three figures depict access to a personal computer in Kentucky; percent of Kentucky adults who have accessed the Internet in the past 12 months, by region; and percent of Kentucky households with a personal computer, by income and education. (TD)

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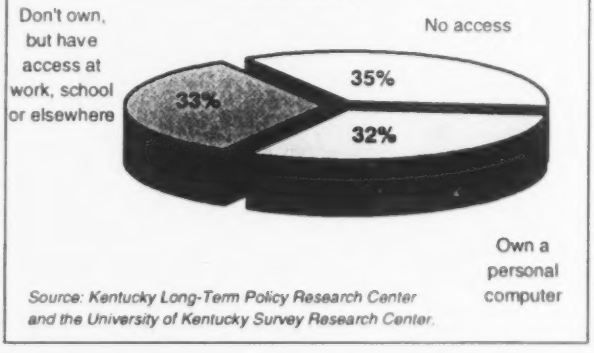
Information Technology: Perspectives and Trends

The full impact of the current information technology and networking revolution remains unknown. But the experiences of organizations and individuals who are "connected"—using the tools and resources offered by information technology—suggest that it may change our social fabric. Some of the current and emerging trends in information technology include: the need to provide equitable access; timely solutions to the "Year 2000" problem; and the transformation of organizations. Government will be challenged by many public policy issues related to information technology, which include, but are not limited to: electronic records management; privacy; security; network literacy; organizational change; intellectual property rights; information access, storage, and retrieval; and public-private partnerships. By developing innovative solutions and responses to these trends, we can better position Kentucky for a prosperous future.

By Doug Robinson
Kentucky Information Resources Management Commission

Information technology (IT) continues to have a major influence on the lives of Kentuckians[1] even though it remains seemingly transparent to most citizens. People have accepted the convenience of an information infrastructure that offers automated teller machines, telephone voice response, on-line transactions and point-of-sale registers at the checkout line. High-speed networks traverse the state and nation connecting retail stores to devices that automatically record purchases, transmit inventory data to suppliers, and keep the products we want on the shelves. While dramatic advances in computing and communications continue at a pace that nearly defies comprehension, it is evident that IT will continue to improve the quality of life in Kentucky, and, simultaneously, create challenging public policy issues.

FIGURE 23.1
Access to a Personal Computer in Kentucky



Source: Kentucky Long-Term Policy Research Center and the University of Kentucky Survey Research Center.

The convergence of the computing and communications infrastructure has opened and continues to open new possibilities for access to information and delivery of services. The advancement of this information infrastructure makes Kentucky more competitive by providing critical support for education, health care, commerce, and government. Indeed, the information revolution is being experienced within many Kentucky households. According to a recent survey, about one third of Kentucky households own a personal computer, which is very close to the national average.[2] In total, approximately two thirds of Kentucky adults have access to a personal computer at home, work, or school (Figure 23.1), and about one in five Kentucky adults has accessed the Internet.[3]

[1] In this chapter, information technology is defined broadly: computer hardware, software, communication networks, data, services, maintenance, and trained people to maximize its use. Likewise, the view of the "information infrastructure" is extended beyond just the physical network of copper and fiber lines to include end-user devices like personal computers (PCs), the data or content delivered over the infrastructure, and the trained people necessary to effectively use the network.

[2] Schirmer, P. (1996). Computer and Internet use in the Commonwealth. *Foresight, 3*, pp. 7-9.

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Schools, however, are seen as the great equalizer in the technologically enabled society. Until every home is "wired," the school can provide access to the benefits associated with the evolving electronic age. The connection of schools to the "ubiquitous" networks enables retrieval of an exponential body of resources—virtual libraries. Moreover, all types of curricula are available, regardless of student/classroom locations, both in subject matter as well as educational medium (e.g., multimedia, simulation). Similarly, the use of network discovery tools serves to equalize the exposure of students to a wide range of resources and events that many would not otherwise be able to experience, such as "virtual" museums that can be accessed through multimedia systems. The advantages for teachers and for curriculum development are realized through the ability to access information resources from classrooms and to communicate with other educators and resources throughout the nation and the world (via the Internet/National Information Highway).

The overarching question is whether appropriate investments in and use of information technology will lead to prosperity for Kentuckians.

The use of IT also permits increased parental involvement through the ability to monitor a student's progress on a day-to-day basis via electronic postings of homework, timely messages from and interactions with teachers, etc. Increased administrative efficiencies for teachers and administrators will also be realized through enhanced computing and networking applications in support of administrative needs, such as attendance, financial reporting, and e-mail.

In addition to its profound influence on education, the technological revolution is transforming organizations, public and private. Information technology has evolved as an agent of change that enables timely responses to social and economic trends in a global information-based economy. Marketplace dynamics and a diverse, mobile and aging population require new approaches to the way we select and deploy technology. Additionally, consumer and citizen demands for choice, convenience, and ease of use in the delivery of goods and services must be achieved in an era of organizational downsizing and strained budgets. At the same time, deregulation and telecommunications reform promise to turn our view of the "telephone company" upside down.

While information technology holds the promise of meeting many challenges in the years ahead, it is not a silver bullet. Several current and emerging information technology trends receive a more detailed examination in the next section.

Current and Emerging Trends In Information Technology

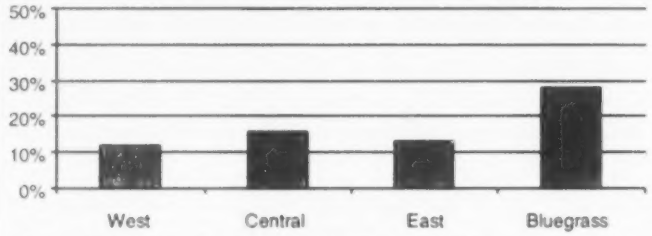
No one knows the full impact of the current information technology and networking revolution, but the experiences of organizations and individuals who are already "connected"—using the tools and resources offered by technology and communications—suggest that it is likely to produce fundamental change in our social fabric. These changes may not all be positive if basic access and public policy issues are not addressed and resolved. The overarching question is whether appropriate investments in and use of information technology will lead to greater prosperity for Kentuckians.

There is and will be a need to provide access to the "information network." The provision of a ubiquitous information network is the most consequential change envisioned for the future of Kentucky. Such a network would enable timely access to global information highways and resources by any and all Kentucky businesses, governmental entities, citizens and students. Advanced statewide networking to support the operations of Kentucky state government and others is now a reality. The Kentucky Information Highway (KIH) is a statewide, integrated communications and information network. First brought on-line in 1995, this major state initiative puts

[1] Schirmer. Survey results suggest that 20 percent of Kentuckians have accessed the Internet. This compares favorably with the U.S. average of 19 percent.

Kentucky at the forefront in terms of telecommunications infrastructure and breaks many of the barriers traditionally imposed by geography, demographics and economics. This network, with an "access ramp" in each of Kentucky's 120 counties, offers tremendous advantages for communities and citizens in government services, education, health care, economic development, public safety and access to information resources.

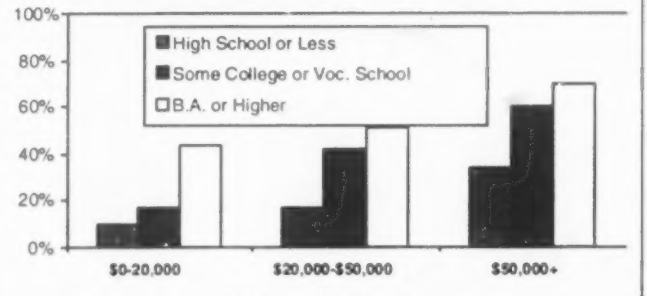
FIGURE 23.2
Percent of Adults Who Have Accessed the Internet in the Past 12 Months, by Region



Source: Kentucky Long-Term Policy Research Center and UK Survey Research Center

This statewide digital network provides for the high speed, high capacity delivery of voice, data and video transmissions. It incorporates existing communications systems used by the state with advanced capabilities and expanded services. With state government as the catalyst and anchor tenant on this new information network, all Kentuckians ultimately benefit from the accelerated deployment of technology and services throughout the state. Because of the state's substantial purchasing power, lower per-unit costs for voice and data communications are available, making statewide long-distance calling and computer connections less costly. In addition to handling all of state government's communications, the KIH is available to cities, counties, schools, libraries and others across the state at the contract rate for voice and data services. This not only directly assists these groups, but also stimulates the expansion of private Internet service providers, with local Internet access now available in almost every Kentucky county.

FIGURE 23.3
Percent of Households with a PC by Income and Education of Respondent



Source: Kentucky Long-Term Policy Research Center and UK Survey Research Center

Today, rural parts of the Commonwealth have equal access to the network and all the advanced technology services available through it. In addition to directly serving state agencies, the network offers tremendous opportunity for applications in the fields of education and health, as well as enabling the development of our economy. In fact, via the KIH, Kentucky was the first state to connect all of its school districts to the Internet. The KIH enhances the Commonwealth's ability to deliver vital public services and provide greater access to all Kentuckians.

Providing equitable access is a fundamental and sustaining necessity for equalizing opportunities in both the public and private sectors, especially for those entities located in an isolated or limited environment. The issue of equity involves providing access to other organizations, citizens and groups via the network, as well as access to information. Recent survey information from the Kentucky Long-Term Policy Research Center and the University of Kentucky Survey Research Center shows that access is affected by income, education, and the region in which people live (See Figures 23.2 and 23.3).[4] Access must be enabled and secured in support of education, whether in urban, suburban or rural areas, or in rich or poor neighborhoods. Points or

[4] These figures are from Schirmer.

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methods of access or intelligent devices must be provided to those without personal computers to prevent limitations of access due to economic status.

The date change to the next century will cause major difficulties in the world of computing devices. This issue, dubbed the "Year 2000" problem, represents the greatest threat to computers since the chip was invented. Since the early years of data processing, computer programmers stored the year in two digits in order to reduce software code and save costly disk storage. If the computer system or its software applications use two digits to represent the year, the change from 1999 to 2000 and beyond may disrupt applications and skew the accuracy of calculations. Any business, government, school or organization that uses a computer will be affected by this problem, which affects many of the processes we depend on every day, including payrolls, invoices, inventory systems, payment calculations and credit card transactions. Applications that manage expiration dates, policy renewals, and financial projections are candidates for failure *now* because they use future timetables. This problem not only affects information technology software, but also devices that use chip technology in manufacturing, retail operations and production processes.

The price tag to fix the problem is significant, primarily because of the magnitude of the situation and its labor-intensive nature. The Gartner Group, an IT consulting firm, estimates the worldwide cost for fixing the Year 2000 problem at $600 billion. The estimated cost for correcting this problem in state government agencies alone is more than $10 million. Many organizations have not addressed the Year 2000 problem because it is so daunting and time consuming. It may take months to analyze, change and test millions of lines of software code that support their activities. What's more, this massive undertaking must be accomplished while normal business activities are ongoing. All existing computers must be tested and new hardware and software procurements must be made that are Year 2000 compliant. If unaddressed, the economic impact could be enormous as public sector agencies are unable to serve citizens and businesses remain noncompetitive as they struggle to correct the problem in late 1999.

Information technology will transform the operations of businesses. The internal culture of organizations will change as a consequence of the proliferation of computing and networking. Flatter organizational structures will be supported by the diffusion of and access to information technology by any and all involved employees. Decentralized decisionmaking will be further enhanced as information and knowledge are made readily available throughout organizations.

Structurally, information technology will permit the evolution of the "virtual office" through employment alternatives such as telecommuting (working from home or remote locations), which will change the dynamics of the work environment, as well as workforce characteristics. The expanding information infrastructure will also allow "information intensive" firms to locate in rural or remote areas. Liberated from the constraints of time and geography, firms will be able to conduct business with customers and vendors. Quality-of-life concerns have driven many corporations and individual entrepreneurs to seek small town and rural locations with the requisite infrastructure to support their operations. Over the long term, this trend could certainly benefit Kentucky as businesses seek locations with the unique qualities of the Commonwealth. Such trends have prompted state, local and community groups to attract industry by providing ready access to telecommunications. Examples include the Kentucky Science and Technology Council's rural televillage initiatives in Pikeville and Elizabethtown.

The workplace in the near future may not appear vastly different from today, but behind the scenes information technology will be a major force in changing the way organizations do business and where they do business.

The workplace in the near future may not appear vastly different from today, but behind the scenes, information technology will be a major force that will alter the way organizations do business and where they do business. The workforce will be comprised of more knowledge workers whose jobs will encompass extracting valuable information from internal and external resources—making sense of "what's out there" and utilizing it to benefit the organization. Outpacing IT's initial objective of processing data faster is the real value enhancement provided by IT to organize, manage, and link information sources and users. Increasingly, these links will embrace outside organizations that have traditionally been disconnected. In turn, metadata issues (information about information) will become a central concern as firms seek to extract meaning from the large repositories of information resources.

Electronic commerce (EC), which integrates communications, data management and security to allow organizations to transact business and exchange information electronically, will also become mainstream. EC differs from traditional commerce primarily in the way information is exchanged and processed, offering significant benefits due to its efficient capture and processing of standard business transactions. A core technology for EC is Electronic Data Interchange (EDI), a secure computer-to-computer transfer of trading partner data within an accepted set of standards. Another technology for EC is electronic funds transfer (EFT), which offers significant efficiencies and enhanced revenues through the immediate, electronic transfer of funds via a bank clearinghouse network. EC may also be represented by other technologies, including interactive telephone response, fax processing, electronic forms and bar coding.

Over the next decade, public and private organizations will move rapidly toward electronic commerce to support quick responses to changing customer service needs. EDI is a critical component used to integrate many facets of the electronic commerce trend and involves the use of software, data transport networks and professional services to allow organizations to share needed information. EDI is now mainly operational in the banking, retail, insurance, automotive, government and health care industries, where it enables immediate access and transactions based on core data elements. The results are such benefits as lower inventory costs, fewer out-of-stock items, and lower transportation costs. Many firms now view electronic commerce as a competitive necessity.

Public Policy Issues

Although the private sector will provide many of the networks, devices, services and training that comprise the information infrastructure, government participation and resolution of public policy issues is vital. As is often the case, technology and the ability to utilize it has eclipsed fundamental policies and procedures available to address concerns over use and misuse, access, security, management and costs. Without a proactive and articulated set of guidelines, the best interests of government and the people of Kentucky are not well protected. Private industry will most certainly build and manage statewide networks, provide the information tools, and develop many of the applications that use the networks. Public agencies will be responsible for most of the content, information resources management and service delivery concerns. In the ever more complex, technological and bureaucratic information environment of the next decade, the issue of access, digital records, security, privacy and electronic government will require far more attention from policymakers. Several of the more prominent issues are:

Electronic Records Management. As more and more public records are created, stored and manipulated in an electronic format, public agencies must address the realities of network access and the necessity for electronic dissemination. Citizens and organizations will not only request but demand open records in an electronic format. Public agencies should assume a proactive stance and make records available in a format that can be easily transmitted under accepted protocols and that will be available through easy-to-use, low cost services. Also, appropriate archival methods need to be enacted to preserve the intended useful life of electronic "public records."

Privacy. Privacy is an important issue that will become critical as more application areas involving sensitive information about individuals and organizations are collected and stored electronically by state agencies. Such information includes records of health care, tax returns, government services, driver's licenses, education and personnel data. The ways in which private companies use or misuse personal data receives constant attention. While privacy concerns are easily appreciated, other less apparent areas are affected as well. For example, while library patrons increasingly accept materials in digital form accessed over networks, such acceptance is still far from universal. Some are concerned that the use of electronic technology provides an easy way to monitor what people are reading, researching or "doing." Recently, the monitoring of electronic mail has become an issue for employer-employee relations.

Security. Information security—which includes confidentiality, information integrity, and information authenticity—is an important issue in all of the applications areas considered. Malicious pranksters and criminals skilled in computer use pose many potential threats to the security of internetworked systems. This issue of security from invasions by these parties is vitally important in several areas: (1) ensuring that medical records are not stolen or modified via network resources, (2) delivering benefits to the needy via electronic benefits transfer, and (3) in the electronic commerce, manufacturing, and telecommuting areas, securing and protecting proprietary information and transactions. Network security also must be planned and managed as networks proliferate to prevent sabotage such as computer pranks, virus corruption, or the elimination of a system's operational capabilities.

Network Literacy and User Training. User training—learning how to use the new technologies and applications—will require new approaches in the workplace, the classroom, and the home. Understanding the education and training requirements of advanced information technology applications is a challenge in itself. Increased videoconferencing and distance learning applications through two-way interactive video serve to illustrate the awareness building and training needed to routinely operate and use this technology. In support of the expanding computing and communications infrastructure, government will need to provide resources for both basic and applied IT research, as well as financial assistance for IT education and training. Issues related to user acceptance trends affect this development of "computing literacy," particularly in areas that extend computer-based information services to new groups of users who have been noticeably "computer-skeptical" in the past (e.g., shop floor workers, doctors and the elderly).

Organizational Change Management. Organizational learning closely parallels user acceptance and training. Many applications in the future will involve the development of new ways of doing the job and will require reengineering a business and its mission. New ways of functioning that are distinctly different from current practices will be required to achieve the greatest benefits from high-speed networking applications in many areas. This learning will not always be easy to achieve, and it will require several adjustments: organizational change; new roles and missions for many employees; and retraining. In some cases, professionals with career skills developed over a lifetime will be required to make a transition to the workplace of the future.

Intellectual Property Rights. Intellectual property rights is an important issue in those areas where government and individual intellectual creations (software, images, books) are accessible—and subject to copying—by many people, either directly or via high-speed networks. Libraries are the most obvious areas where this is a concern, but other application areas such as education and government services also are involved. Determining whether a public agency should copyright software created for public business is problematic and fraught with uncertainties. Presently unresolved issues related to how agencies are to be compensated for their work

while still providing for public "fair use" under the proper circumstances will be a key determinant of the quality and availability of government information.

Information Access, Storage & Retrieval. Flexible and timely access to all of the information resources contained across the marketplace of networks—the knowledge of what information is available, where it is, and how to get it in a timely fashion and in a useful form—is important. Such access requires that the information not only be available, but also maintained and kept current. Access to timely, useful information is especially important in applications areas such as geographic information systems, libraries, manufacturing, and environmental monitoring, where large quantities of data must be sorted, stored, retrieved, and managed. The issues related to the operation of "information locator" services present additional management complexities and resource requirements.

Public-Private Partnerships. As the development of secure IT infrastructure necessitates large expenditures and commitments, public policies must address the right mix of public and private sector participation. Partnerships must be obtained to protect the investment of both sectors. Additionally, appropriate incentives for the private sector must be offered to sustain competition and investment in IT research and development. Similarly, perspectives and approaches must be endorsed by both sectors to sustain a progressive IT environment that will permit a satisfactory technology transfer process. Effective IT management involves maintaining innovative and responsive policies to allow the maximum benefits from timely deployment of rapidly changing technologies.

Conclusion

Information technology will be an agent of change in the 21st century, one that will continue to compel attention to the development and maintenance of critical infrastructure—a basic building block for the future of Kentucky. With the appropriate infrastructure in place, organizations, especially in the public sector, can effectively use information technology to promote, refine, and speed services to the public. In order to do so, new skills and resources, as well as the management of inevitable organizational change, will be required to capture full use of the immense potential of information and communications technology.

Significantly, information technology enabies innovation, creativity and competitive advantage that can enhance performance in both the public and the private sectors. Consequently, the ability to effectively use and manage IT is not only a challenge for all sectors of the Commonwealth, it is an economic imperative. However, given its inherent complexity and its cost, strong partnerships between the public and private sectors will be necessary to bring the full benefits of IT to all sectors. Over the long term, the strategic application and management of IT can help Kentucky maximize the use of limited resources to meet its pressing needs, achieve a stronger competitive position in the global economy, meet the increasing demand for customer service, increase confidence in government, and approach solutions differently in such areas as education reform, employee development and empowerment, flexible manufacturing, and industrial revitalization. IT is, in effect, a tool for change that can enable the Commonwealth to realize more of its tremendous potential in the new millennium.